ThermoChem, Inc.

Steam Reforming of Low-Level Mixed Waste

Technology Need:

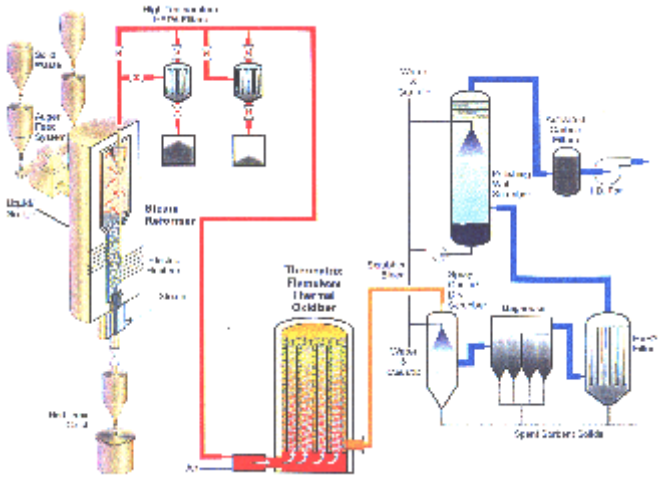
The Department of Energy (DOE) has generated, and continues to generate, large quantities of low-level mixed waste (LLMW) that require treatment prior to disposal. Existing treatment systems are expensive to operate and difficult to permit. Treatment systems are needed that reduce the volume of waste for final disposal, isolate the radionuclides in an acceptable final waste form, and destroy the hazardous component(s) in the LLMW.

Technology Description:

Manufacturing and Technology Conversion International, Inc. (MTCI) has developed a patented, steam-reforming system which reacts the LLMW organics with superheated steam, generating a hydrogen-rich gas, and isolates the radioactive and nonradioactive inorganics in a form readily suitable for encapsulation and/or vitrification. Steam reforming takes place in an indirectly heated, fluidized bed reactor resulting in high throughput, high flexibility, complete organic destruction, and improved economics.

ThermoChem is the exclusive licensee to MTCI's patented steam-reforming system. The heart of this steam-reforming system is an indirectly heated, fluidized bed reactor. Superheated steam fluidizes the bed and reacts with the organics in the waste feed material. The fluidized bed offers an ideal environment for effecting the endothermic steam-reforming reaction while retaining high processing throughput.

The steam-reforming reaction converts organics to a hydrogen-rich synthesis gas and converts chlorinated compounds to hydrochloric acid (HCl) which is subsequently removed. Dioxins and furans are not formed and, in fact, if dioxins are present in the feedstock, they will



Process Developing Unit Flow Diagram

be destroyed in the reducing environment of the reactor. In the LLMW application the steam reformer is operated at temperatures that ensure retention of the lower-melting-point inorganics and radionuclides in the bed. The inorganic bed material is removed and processed for final disposal using a technique such as vitrification. The synthesis gas is catalytically oxidized and released as carbon dioxide and water vapor.

The ThermoChem steam-reforming system configured for treatment of LLMW in either liquid or solid form with halogenated organics (including polychlorinated biphenyls [PCBs]), heavy metals, and radioactive elements would consist of the following major subsystems:

<Solid/liquid receiving, sorting, feeding subsystem

<Indirectly heated fluidized bed steam reformer with internal cyclone

<High-efficiency particulate air (HEPA) filter for fines capture

<Flameless thermal oxidizer

<Gas cleanup subsystem containing spray cooler/dry scrubber for acid gas removal, caustic feed system for scrubber, baghouse and HEPA filters for solid salts removal, polishing wet scrubber for acid gas, activated carbon filter for mercury removal, and induced draft blower

<Boiler and superheater

<Solid residue treatment/packaging system

<Exhaust stack and continuous emissions monitoring system

<Instrumentation and controls

Benefits:

<Non-incineration method for treating a wide variety of low-level hazardous waste and LLMW

<Volume reductions of 20-200 to 1

<Destroys hazardous organic materials (99.99+%) with no dioxin formation

<Final waste streams easily coupled with vitrification and/ or encapsulation for final disposal of LLMW

Status and Accomplishments:

This project was concluded in September 1998. ThermoChem successfully completed design, construction, and testing of a 1 ton/day Process Development Unit (PDU) using mixed waste surrogates. Surrogate feedstocks included natural aqueous wastes, aqueous halogenated organics, high organic sludge, absorbed aqueous organics, sludges, ashes, and solids. Among the surrogates tested was a Portsmouth Gaseous Diffusion Plant (Portsmouth) PCB and uranium solid waste.

Testing in the PDU on Resource Conservation Recovery Act (RCRA) and Toxic Substance Control Act (TSCA) organic compounds has confirmed that the ThermoChem overall system will achieve up to 99.9999% Destruction Removal Efficiency (DRE) for the principal organic hazardous constituents (POHC) found in DOE wastes. PDU tests have verified complete retention of Cesium and heavy metal compounds as a solid in the first-stage reactor bed material and volume reductions typically in the range of 20 -200 to 1 and as high as 1,000 to 1 for certain high organic content wastes.

The ThermoChem steam-reforming system has been successfully tested on a wide spectrum of feedstocks such as biomass, industrial sludges, municipal solid waste, and sewage sludge. In 1995, a long duration demonstration test was successfully completed in a 5,000 pound-per-hour system processing caustic spent liquor from a wood pulping mill. ThermoChem is currently marketing its PulseEnhanced™ steam-reforming system to pulp and paper manufacturers. Demonstration and deployment planned for the Portsmouth site was canceled due to a lack of funding.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 273
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For additional information, please visit ThermoChem's website at http://www.thermochem.com/